Perspectives in Practice

The 2005 Dietary Guidelines Advisory Committee: Developing a Key Message

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ABSTRACT

The 2005 Dietary Guidelines Advisory Committee used an evidence-based approach to evaluate the science base for the relationships of diet and physical activity and health. Nine key messages and corresponding conclusions were included in the 2005 Dietary Guidelines Advisory Committee report. This article describes the development process, scientific basis, and specific recommendations for one of the key messages.

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The 2005 Dietary Guidelines Advisory Committee report was submitted to the Secretary of Health and Human Services and the Secretary of Agriculture on August 23, 2004 (1). In that report, the Dietary Guidelines Advisory Committee outlined a set of nine key messages.

Unlike in previous Dietary Guidelines, an evidence-based approach was used to develop the key messages. The 2005 Dietary Guidelines Advisory Committee used this approach because it is a more systematic way of providing scientific documentation for the rationale behind the key messages.

Because of the workload involved in this approach, the committee formed several subcommittees to distribute and manage the work. Subcommittees initially included nutrient adequacy, carbohydrates, fats, fluid and electrolytes, energy, ethanol, and food safety. Later, during the deliberative process, additional subcommittees were formed to review macronutrients and food groups.

Each subcommittee generated a list of research questions that were relevant to setting the new Dietary Guidelines. For each question, a thorough review of the scientific literature was conducted, national data sets were analyzed, and additional information was obtained from outside experts. For each content area, key nutrients and their important health outcomes were identified. Then, based on the literature, the strength of the relationship between those nutrients and decreased risk of disease was determined and summarized in conclusive statements. Each subcommittee presented its findings to the full Dietary Guidelines Advisory Committee and the conclusions, which formed the basis for the nine key messages included in the Dietary Guidelines Advisory Committee report, reflect the consensus of the entire committee.

The first key message of the 2005 Dietary Guidelines Advisory Committee report is to "consume a variety of foods within and among the basic food groups while staying within energy needs." This key message was generated by the nutrient adequacy subcommittee. This article describes the development process, scientific basis, and specific recommendations of this key message. Specifics of the science base and the supporting evidence can be found in the technical report (1).

MATERIALS AND METHODS

The Subcommittee Process

The nutrient adequacy subcommittee consisted of four Dietary Guidelines Advisory Committee members, one of which served as the lead member. This subcommittee generated five major research questions related to achieving recommended intakes of nutrients:

- What nutrients are most likely to be consumed by the general public in amounts low enough to be of concern?
- What dietary patterns are associated with achieving recommended nutrient intakes?
- What factors related to diet or physical activity may help or hinder achieving recommended nutrient intakes?
- How can the flexibility of the food patterns be increased?
- Are special nutrient recommendations needed for certain subgroups?

For each research question, the subcommittee synthesized its critical review into one or more conclusive statements. The conclusive statements were then used as a basis for a key message.

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Table 1. Probabilities of adequacy for selected nutrients on the first 24-hour recall among adult Continuing Survey of Food Intakes by Individuals (CSFII) (1994-96) participants[a]

Nutrient	Probability of Adequacy (%)	
	Men	Women
Vitamin A[b]	47.0	48.1
Vitamin C[b]	49.3	52.3
Vitamin E[b]	14.1	6.8
Thiamin	83.9	72.2
Riboflavin	85.8	80.9
Niacin	90.5	80.4
Folate[bc]	33.9	20.9
Vitamin B-6	78.3	60.7
Vitamin B-12	80.5	64.2
Phosphorus	94.3	85.1
Magnesium[b]	36.1[b]	34.3
Iron	95.5	79.4
Copper	87.4	73.3
Zinc	65.7	62.0
Calcium[b]	58.6	45.7

[a]Source: data from reference 4.
[b]Shortfall nutrient.
[c]The probability of folate adequacy is underestimated because the folate intake values are expressed in milligrams of folate rather than dietary folate equivalents, the unit used in Dietary Reference Intakes. Dietary folate equivalents account for the higher percent absorption of folate from foods fortified with folic acid, whereas milligrams of folate do not. Moreover, the food intake data from 1994-1996 do not reflect the current fortification of enriched grains with folic acid, required since 1998.

Question 1: What Nutrients Are Most Likely to Be Consumed by the General Public in Amounts Low Enough to Be of Concern?

The committee concluded that reported dietary intakes of several selected nutrients were low enough to be of concern. Efforts are needed to promote increased intakes of vitamins A and C, calcium, and magnesium among adults; of calcium and magnesium among children aged 9 years or older; and of vitamin E, potassium, and fiber regardless of age. Further, efforts are especially needed to improve nutrient intakes among female adolescents, particularly for calcium. These conclusions are supported by scientific reports on the probability of adequate and inadequate dietary nutrient intakes in the US population and on data from the Centers for Disease Control and Prevention and the Agricultural Research Service. Reports that applied or adapted the nutrient assessment methods suggested by the Institute of Medicine for nutrients were used when available. Published data were available for vitamin E (2), for school children's intakes of 13 nutrients (3), and for adults' intake of 15 nutrients (4).

For adults, the probability of adequate dietary intake of vitamins E, A, and C; folate; calcium; and magnesium was <60% (Table 1). Mean intakes of potassium and fiber were far below the Adequate Intake (AI) for all age groups. For children (Table 2), the probabilities of inadequacy for a nutrient were significant for vitamin E, folate, and magnesium. Approximately 80% of all children surveyed had usual intakes of vitamin E that were below the Estimated Average Requirement (EAR). Median calcium intake was well below the AI beginning at age 9 years and was particularly problematic for female adolescents aged 14 to 18 years (2). The reportedly high percentage of children and adults with folate intakes below the EAR may be an overestimation (2,3) because the data were collected before the US Food and Drug Administration required the fortification of enriched grains with folic acid. More studies are needed to determine if folate intake is of concern among adult women in particular or the public in general. The nutrient adequacy subcommittee focused on four of the six major shortfall nutrients (vitamin E, calcium, potassium, and fiber) because of the challenges in developing dietary guidance to meet recommended food intakes to achieve nutrient adequacy. Other nutrients are discussed in latter sections of the Dietary Guidelines Advisory Committee report (1).

Question 2: What Dietary Patterns Are Associated with Achieving Recommended Nutrient Intakes?

As the committee began its deliberations, the US Department of Agriculture (USDA) was revising and updating its Food Guide Pyramid food-intake patterns. The committee reviewed these patterns, which were published for comment in the *Federal Register*. The committee concluded that two major aspects of the USDA dietary patterns contribute to meeting nutrient intake recommendations: consumption of foods from each of the basic food groups and consumption of a variety of foods within each of the basic food groups. The committee noted that attention also should be given to food choices that maintain appropriate energy balance, because higher energy intake is strongly associated with greater variety and higher nutrient intake. This conclusion is supported by the food pattern modeling conducted by USDA's Center for Nutrition Policy and Promotion and by a study (4) that linked survey data on food intake with data on nutrient intakes. It also is supported by the information gathered by the committee on the nutrients provided by each of the basic food groups and their subgroups. Each food group provides a wide array of nutrients in substantial amounts; thus, it is important to include items from all food groups in the daily diet. The study by Foote and colleagues (4) found high correlations among energy intake, intakes from the five food groups, and variety of different foods consumed from the basic food groups. Therefore, it was concluded that a combination of energy intake, intakes from the five food groups, and consuming a variety of foods from the basic food groups was a strong predictor of the mean probability of adequacy.

The committee generated 12 food patterns based on total energy intake levels ranging from 1,000 kcal to 3,200 kcal, at 200-kcal increments. These 12 patterns meet most of the nutritional goals set forth by the USDA food intake patterns yet differ from the original Food Guide Pyramid in several ways (1). Briefly, the number of food patterns was increased, discretionary fats were separated into 40% solid fats and 60% oils, the amount of vegetables and vegetable subgroups was increased, and the number of whole grains and nonfat/low-fat milk or milk equivalents was increased.

The food patterns include suggested amounts to consume from each of the basic food groups (Table 3). It is important to note that the food patterns provide more than 100% of the Recommended Daily Allowances (RDA)

Table 2. Percentage of school-aged children whose usual daily nutrient intake was below the Estimated Average Requirement (EAR) for all children and by age and sex, in the Continuing Survey of Food Intakes by Individuals 1994-1996[a]

Nutrient	All	Boys 6-8 y	Girls 6-8 y	Boys 9-13 y	Girls 9-13 y	Boys 14-18 y	Girls 14-18 y
	←			%			→
Vitamin A	10.1	0	0	3	6	15	24
Vitamin C	10.5	1	0	2	9	18	22
Vitamin E[b]	78.9	48	68	70	85	84	99
Thiamin	1.9	0	0	9	0	2	10
Riboflavin	2.1	0	0	0	0	3	5
Niacin	1.9	0	0	0	0	0	5
Vitamin B-6	1.3	0	0	0	2	3	15
Folate[bc]	50.6	13	14	36	59	58	90
Vitamin B-12	1.3	0	0	0	1	0	8
Phosphorus	19.9	0	0	15	37	7	48
Magnesium[b]	36.5	1	0	16	33	62	89
Iron	2.9	1	1	0	0	1	13
Zinc	8.2	0	0	1	11	3	24

[a]Source: reprinted with permission from reference 3.
[b]Shortfall nutrient.
[c]The percentage of children with folate intakes below the EAR is overestimated because the probability of folate adequacy is underestimated because the folate intake values are expressed in milligrams of folate rather than dietary folate equivalents, the unit used in Dietary Reference Intakes. Dietary folate equivalents account for the higher percent absorption of folate from foods fortified with folic acid, whereas milligrams of folate do not. Moreover, the food intake data from 1994-1996 do not reflect the current fortification of enriched grains with folic acid, required since 1998.

Table 3. Revised US Department of Agriculture food intake patterns

Food group	Energy Level			
	1,200 kcal	1,800 kcal	2,200 kcal	3,200 kcal
Fruits (c)	1 (2 srv[a])	1.5 (3 srv)	2 (4 srv)	2.5 (5 srv)
Vegetables (c)	1.5 (3 srv)	2.5 (5 srv)	3 (6 srv)	4 (8 srv)
Dark-green vegetables (c/wk)	1.5	3	3	3
Orange vegetables (c/wk)	1	2	2	2.5
Legumes (c/wk)	1	3	3	3.5
Starchy vegetables (c/wk)	2.5	3	6	9
Other vegetables (c/wk)	4.5	6.5	7	10
Grains (oz equivalent)	4	6	7	10
Whole grains (oz equivalent)	2	3	3.5	5
Other grains (oz equivalent)	2	3	3.5	5
Meat and beans (oz equivalent)	3	5	6	7
Milk (c)	2	3	3	3
Oils (g)	17	22	27	46
Discretionary energy (kcal)	163	190	235	334

[a]srv=servings.

or AI for most nutrients. However, the patterns only provide 50% to 75% of the RDA for vitamin E. As a result, the food patterns provide suggested amounts of oils to consume because they are good sources of vitamin E. The nutrient profiles of the food patterns reflect the lowest-fat forms of each food in the food groups and/or a form free of added sugar. The foods that make up the food patterns could be described as nutrient-dense versions of the foods. The solid fats (eg, whole milk and higher-fat meat products) and added sugars in foods are to be included in the amounts of discretionary energy that are provided for each energy level. Discretionary energy is defined as the total estimated daily energy requirement minus the essential energy. It is evident from the food patterns that people need to increase their physical activity and/or consume nutrient-dense foods that are relatively low in energy density if they want to make discretionary energy available or to increase the amount of discretionary energy they consume (Figure 1). For example, person A consumes nutrient-dense, lower–energy-density foods and fulfills his essential nutrient needs by consuming 1,800 kcal. Since his total energy allowance is 2,000 kcal/day, the remaining 200 kcal is discretionary energy. In contrast, person B, who consumes low-nutrient, high-fat,

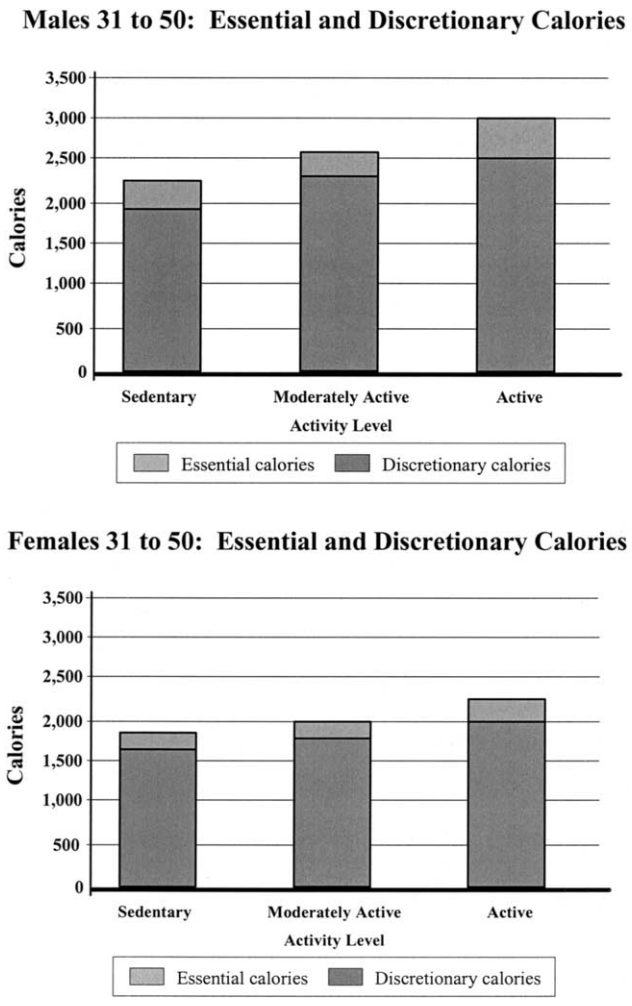

Figure 1. Estimate of discretionary energy available based on level of physical activity for men and women aged 31 to 50 years.

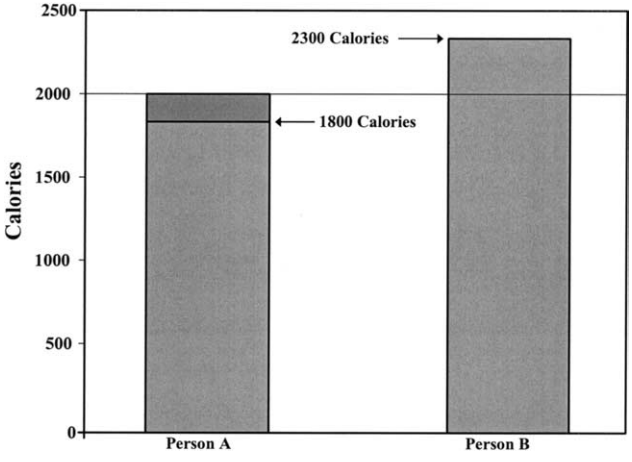

Figure 2. Illustration of the discretionary energy concept.

high-sugar (ie, added sugar) foods, exceeds his total energy allowance before fulfilling his essential nutrient needs. Person B has no discretionary energy and is in an excess energy intake pattern that, over time, will result in undesirable weight gain if his energy expenditure is not increased. Another illustration of the discretionary energy concept is provided in Figure 2.

Question 3: What Factors Related to Diet or Physical Activity May Help or Hinder Achieving Recommended Nutrient Intakes?

The committee identified two factors related to achieving recommended nutrient intakes. First, they concluded that a sedentary lifestyle limits the amount of energy a person needs to maintain his or her weight. For sedentary people, careful food selection and preparation are needed to meet recommended nutrient intakes within appropriate energy levels. Second, diets that include nutrient-dense foods (ie, foods with a high nutrient content relative to energy content) are helpful in achieving recommended nutrient intakes without exceeding one's energy needs. Diets that include a large amount of foods or beverages that are high in energy but low in nutrients are unlikely to meet recommended intakes for micronutrients and fiber, especially for sedentary people.

Unlike in previous Dietary Guidelines, an evidence-based approach was used to develop the key messages.

The higher one's physical activity level, the higher his or her energy requirement and the easier it is to plan a food intake pattern that meets recommended nutrient intakes. People consuming the higher energy intake level food patterns are less likely to fall below recommended nutrient intakes. In addition, the higher energy levels allow more flexibility for foods that contain discretionary energy, such as added sugars and solid fats. For example, the 1,600-kcal food pattern allows for 132 kcal of discretionary energy compared with 648 kcal for the 3,200-kcal food pattern. Because energy intake is the strongest predictor of the mean probability of adequacy for many nutrients (4), increasing physical activity levels is one way to increase one's energy requirement and amount of discretionary energy.

Energy-dense, nutrient-poor foods supply relatively small amounts of vitamins and minerals with many kilocalories, whereas nutrient-dense foods provide substantial amounts of vitamins and minerals and relatively little energy. A number of epidemiologic studies suggest that energy-dense, nutrient-poor foods may displace nutrient-dense foods in a person's diet, potentially reducing the consumption of foods from the five food groups to levels below what is recommended and limiting one's ability to achieve recommended nutrient intakes (5-7). For example, people consuming a high proportion of energy-dense, nutrient-poor foods are more likely to report either no servings or less than the recommended number of servings of foods from the major food groups (5). Further, the strongest independent negative predictor of the number of low–nutrient-dense foods reported was the

reported amount of nutrient-dense foods from the five major food groups (8).

Dietary diversity among and within food groups is not related to total energy, fat, sugar, sodium, or cholesterol intake (9). However, people who consume the greatest variety of foods among the food groups have the most adequate nutrient intakes (10). In addition, people who are offered several different foods consume more total food than when variety is more restricted (11-16). In contrast, intake of a variety of vegetables results in decreased energy intake and body fatness (17). The long-term effects of dietary variety on food intake and body weight are unknown and warrant further investigation.

Choosing foods that are rich sources of nutrients in short supply can be an effective way to put the concept of nutrient density into action. Using the food pattern that is appropriate for one's energy needs based on age, sex, and activity level is one way to achieve a diet that meets recommended nutrient intakes.

Added sugars are defined as sugars and syrups that are eaten separately at the table or added to foods during preparation or processing. Studies show that higher intakes of added sugar are associated with a decreased intake of at least one micronutrient. However, small amounts of added sugars may have a beneficial effect on intake of vitamins and minerals, probably by improving the palatability of foods and beverages that might not otherwise be consumed.

Question 4: How Can the Flexibility of a Food Pattern Be Increased?

The committee concluded that substitutions can be made to a food-intake pattern and still achieve recommended nutrient intakes. Empirical methods were used to identify ways to build flexibility into the food-intake patterns. Additional food-pattern modeling and other nutrient analysis methods were used to identify ways to increase the flexibility of the proposed USDA food patterns. The additional modeling exercises included identifying substitutions for refined grain products, legumes, and milk and milk products; developing a lacto-ovo-vegetarian food pattern that met the nutritional goals; and comparing the nutrient contributions of fruits with fruit juices.

Some persons choose not to eat legumes or refined grains, so a list of specific amounts of other food groups or subgroups that could be substituted without substantially changing the overall nutrient adequacy or energy balance of a food pattern was generated. To substitute for each $^1/_2$ c legumes in a food pattern, grain increases of 0.5 oz to 1.5 oz, dark green leafy vegetable increases of 1 $^1/_2$ c, or other vegetable (eg, tomatoes, lettuce, or green beans) increases of 2 c would be necessary to meet the nutritional goals for magnesium, iron, calcium, and dietary fiber.

The milk group contributes important amounts of calcium, potassium, magnesium, and vitamin A. To meet nutritional goals, a food pattern without milk or milk products would need to include a much larger amount of calcium-containing green leafy vegetables and legumes. Both calcium content and bioavailability should be considered when selecting dietary sources of calcium. Some plant foods have calcium that is well absorbed, but the large quantity of plant foods needed to meet calcium goals may be unachievable for many. For people concerned with lactose content, the most practical way to obtain all the nutrients provided by dairy is to substitute lactose-reduced or low-lactose milk products.

The committee also examined appropriate proportions of fruits and fruit juices in the fruit group. This analysis was conducted based on a recent recommendation of the American Academy of Pediatrics to limit fruit juice in children's diets. Based on the fruit-group analysis, the subcommittee's recommendation was to consume no more than one third of the total recommended fruit-group intake amount from fruit juice and the remainder from whole fruit (ie, fresh, frozen, canned, or dried), assuming a $^3/_4$ c serving of juice to equal $^1/_2$ c fruit. Increasing the proportion of fruit that is eaten in the form of whole fruit rather than juice is desirable to increase fiber intake, but requires consumption of additional foods that are high in potassium to achieve potassium goals. In usual portion sizes, the fruit juices most commonly consumed by older children and adults provide more vitamin C, folate, and potassium than do commonly eaten fruits. The recommended intake of fruits and juices achieves a balance of fiber and nutrients.

Choosing foods that are rich sources of nutrients in short supply can be an effective way to put the concept of nutrient density into action.

The committee also examined how substituting nuts, seeds, and legumes for the meat, poultry, and fish in a food pattern would affect the nutrient profile of the food group. The amount of eggs in the pattern remained constant. Although the nutrient profile of the egg, nut, seed, and legume group differed in some ways from the original meat and beans group, it still provided a food pattern that met recommended nutrient intakes. The lacto-ovo-vegetarian pattern was higher in vitamin E, fiber, and folate than the original food pattern. It was lower in protein, some B vitamins, and zinc, but pattern levels were at or above recommendations.

Question 5: Are Special Nutrient Recommendations Needed for Certain Subgroups?

The committee concluded that special nutrient recommendations are warranted for the following subgroups:

- female adolescents and women of childbearing age (iron and folic acid);
- people older than age 50 years (vitamin B-12); and
- elderly people, people with dark skin, and people exposed to insufficient ultraviolet B (UVB) radiation (vitamin D).

Substantial numbers of female adolescents and women of childbearing age have iron deficiency. Iron deficiency (defined as having an abnormal value for at least two of three laboratory tests of iron status) affects 7.8 million female adolescents and women of childbearing age (18).

For these two subgroups, efforts are needed to encourage increased intake of iron-rich foods and intake of enhancers of iron absorption, like foods high in vitamin C.

A daily intake of 400 μg synthetic folic acid (from supplements or fortified food) is recommended for women who are capable of becoming pregnant and those in the first trimester of pregnancy to reduce the risk of neural tube defects in their children (19). It is unclear if the same level of protection could be achieved by consuming foods that are naturally rich in folate (20).

A significant proportion of people older than age 50 years may have reduced ability to absorb naturally occurring vitamin B-12, but they are able to absorb the crystalline form. Thus, all people older than age 50 years should be encouraged to meet their RDA for vitamin B-12 by eating foods fortified with vitamin B-12, like fortified cereals, or by taking the crystalline form of vitamin B-12 via supplements.

Elderly people and people with dark skin are at a greater risk of low serum 25-hydroxyvitamin D concentrations (21-23). Also at risk are those people exposed to insufficient UVB radiation for the cutaneous production of vitamin D. In both young and older subjects (24), serum 25-hydroxyvitamin D values increase with increasing oral vitamin D intake. For people in high-risk groups, substantially higher intakes of vitamin D have been recommended to achieve and maintain healthy serum 25-hydroxyvitamin D levels. Further data are needed to determine if a serum 25-hydroxyvitamin D concentration of 80 nmol/L is sufficient to increase the efficiency of calcium absorption or to reduce parathyroid hormone levels in the population at risk.

CONCLUSIONS

The 2005 Dietary Guidelines Advisory Committee was the first to take an evidence-based approach to creating the scientific report used to develop the *Dietary Guidelines for Americans 2005*. For each of the nine key messages that were generated a comprehensive, systematic review of the science was conducted. A similar evidence-based process will most likely form the basis for the next Dietary Guidelines Advisory Committee report in 2010. The 2005 Dietary Guidelines Advisory Committee was also the first to use the nutrient EARs recently established by the Food and Nutrition Board of the Institute of Medicine to identify nutrients at risk and to develop a diet pattern that better ensures adequate intake of the nutrients at risk.

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